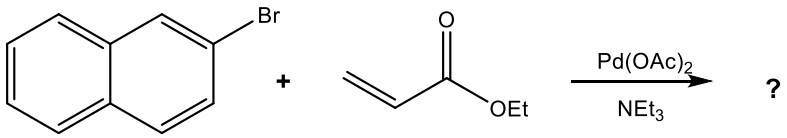
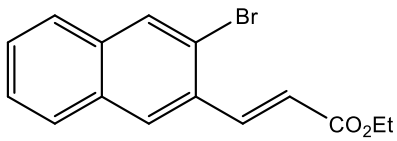
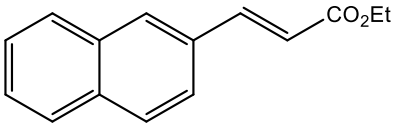
1. Select the major product of the following Heck reaction.

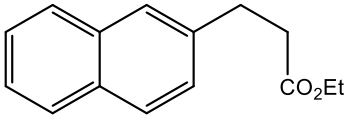




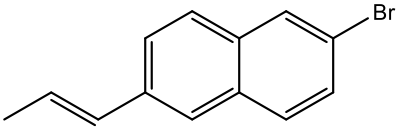
(A)



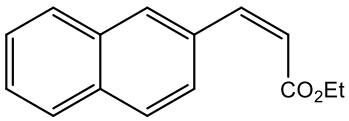
(B)



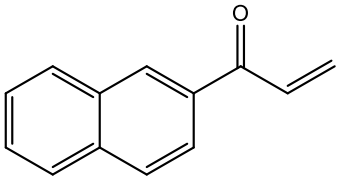
(C)



(D)

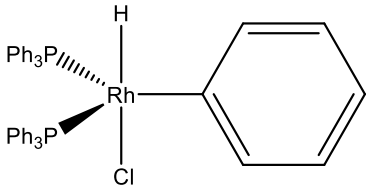


(E)



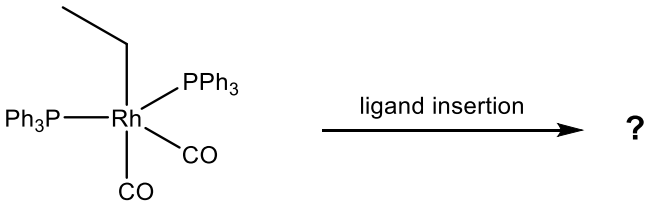
(F)

2. Select the correct number of valence electrons for the following metal complex.

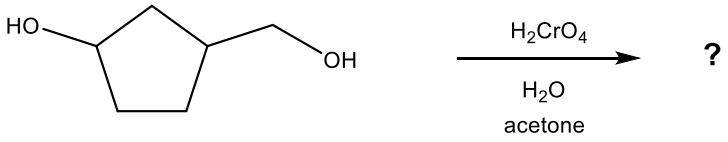


(A) 14 (B) 15 (C) 16 (D) 17 (E) 18 (F) 20

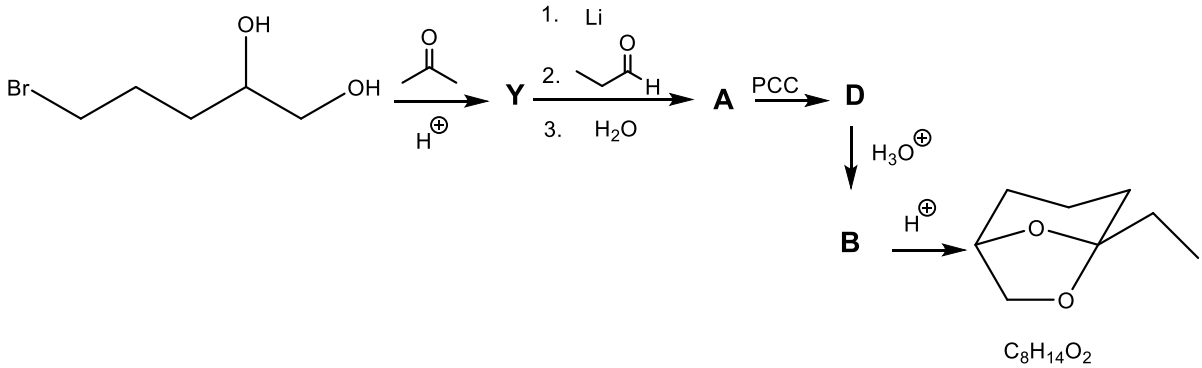
3. Draw the intermediate formed by a ligand insertion step from the intermediate shown.



4. Predict and draw the major product of the following reaction.



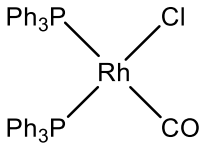
5. The following is a synthesis towards a bicyclic ketal starting from 5-bromo-1,2-pentadiol.



a. Draw the structure of compound A.

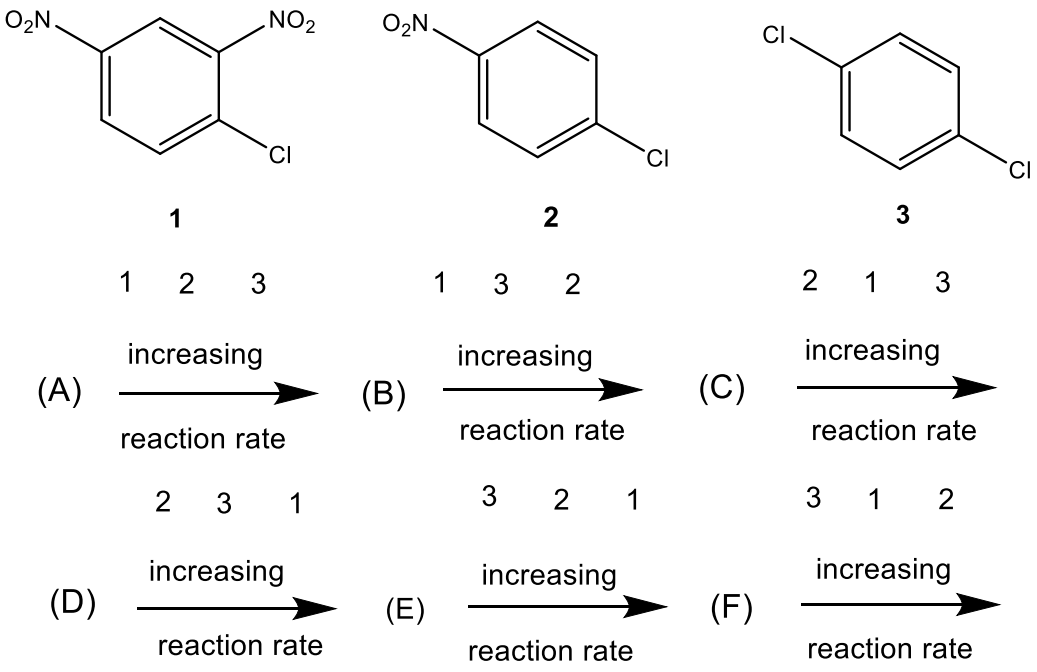
b. Draw the structure of compound B.

6. Which statement is true regarding the rhodium complex shown?



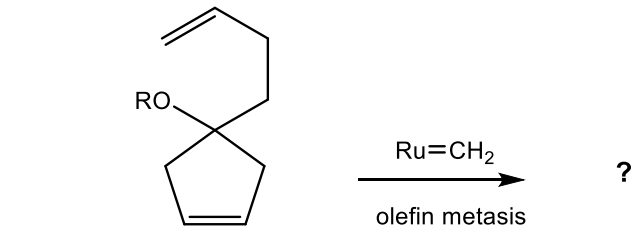
(A) The oxidation state of rhodium is 0 and the number of valence electrons is 16.
(B) The oxidation state of rhodium is 0 and the number of valence electrons is 17.
(C) The oxidation state of rhodium is +1 and the number of valence electrons is 16.
(D) The oxidation state of rhodium is +1 and the number of valence electrons is 18.
(E) The oxidation state of rhodium is +2 and the number of valence electrons is 15.
(F) The oxidation state of rhodium is +2 and the number of valence electrons is 16.

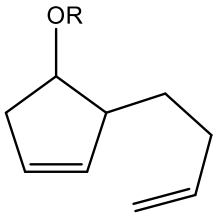
7. Select the order that has the following compounds correctly arranged with respect to increasing rate of reaction with potassium hydroxide (by SNAr).



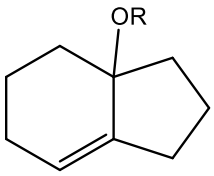
8. Choose the major product of the following olefin metathesis.

(see next page)

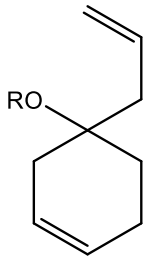




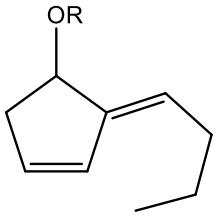
(A)



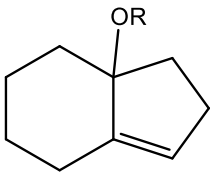
(B)



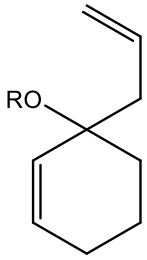
(C)



(D)

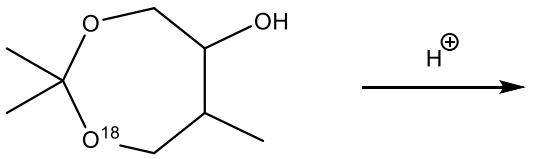


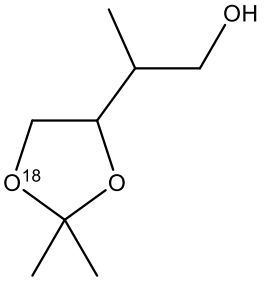
(E)



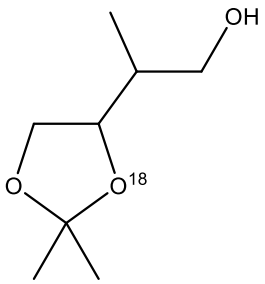
(F)

9. Select the major product(s) of the following isomerization reaction, which utilizes radiolabeling.

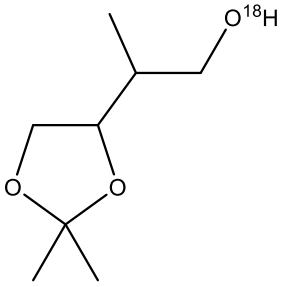




1



2

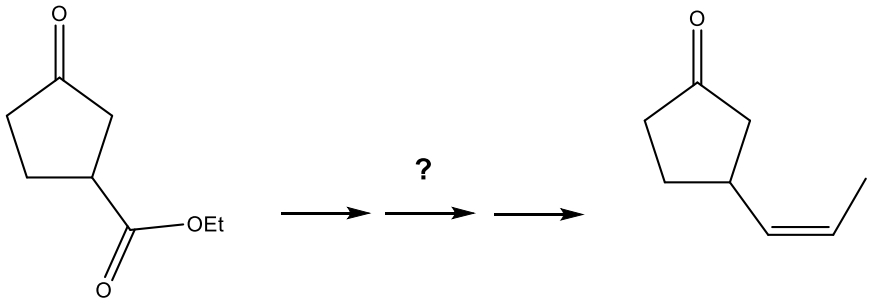


3

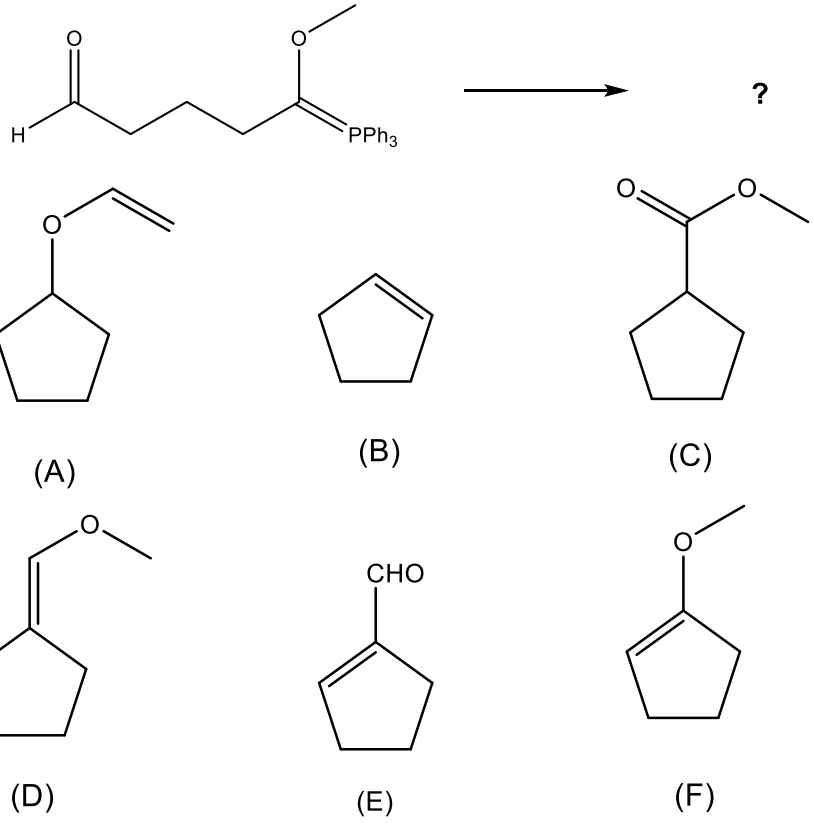
(A) 1 (B) 2 (C) 3 (D) 1 + 2 (E) 1 + 3 (F) 2 + 3

10. Propose a synthesis of the product shown starting from the reactant shown and any other necessary reagents.

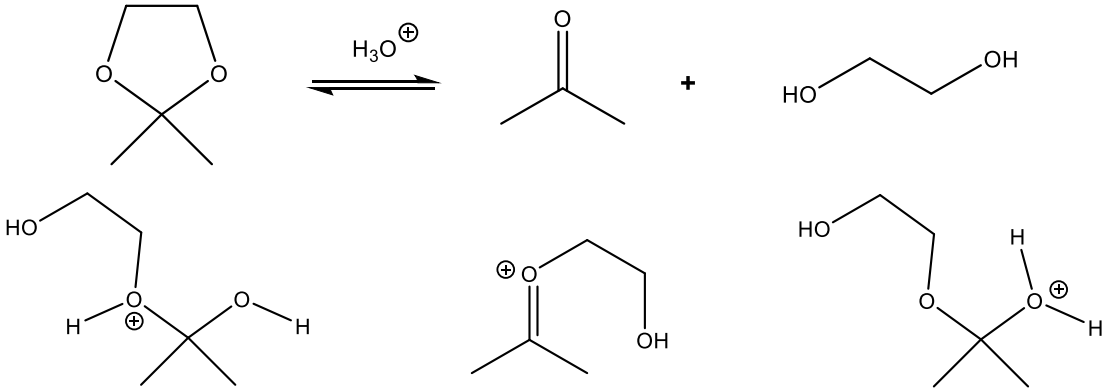
HINT: an efficient synthesis will involve the use of a protecting group.



11. Predict the product of the following reaction:



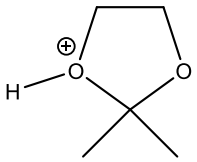
12. Select the intermediate that is least likely formed during the course of the following acetal hydrolysis.



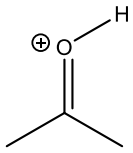
(A)

(B)

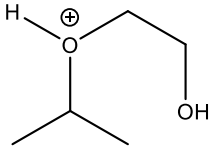
(C)



(D)

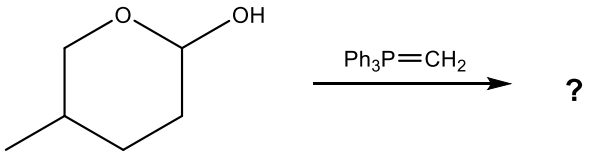


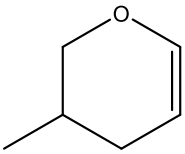
(E)



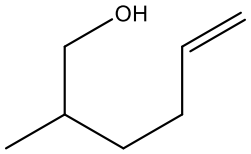
(F)

13. Select the major product of the following reaction.

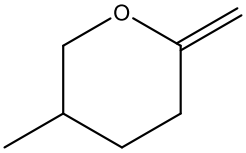




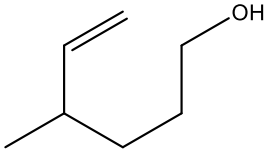
(A)



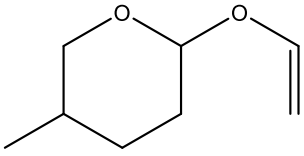
(B)



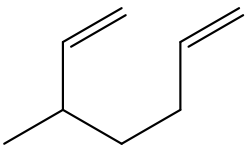
(C)



(D)

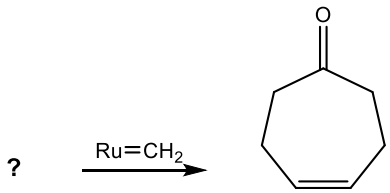


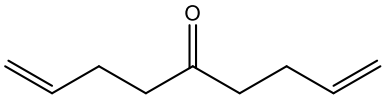
(E)



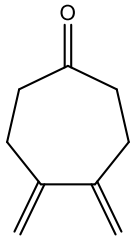
(F)

14. Choose the correct reactant of the following metathesis reaction.

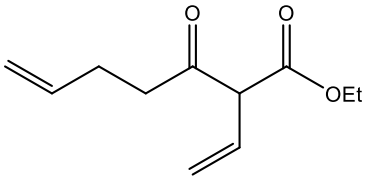




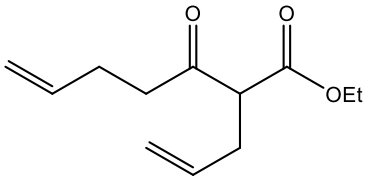
(A)



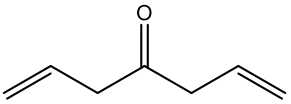
(B)



(C)



(D)



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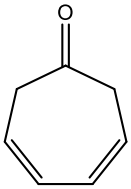
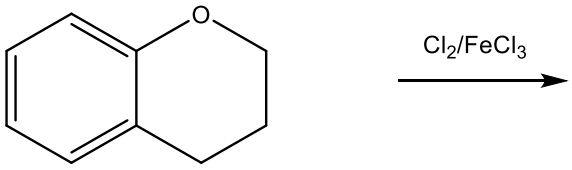
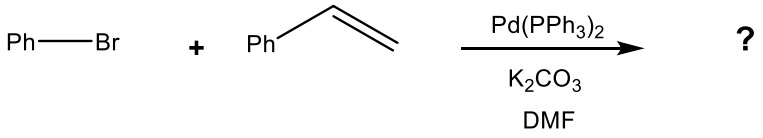


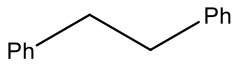
(F)

15. Give the structure of the major product of the following reaction.

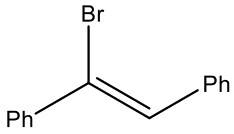


16. Choose the major product of the following reaction.

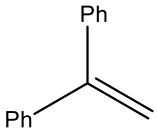




(A)



(B)



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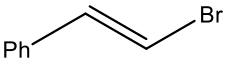
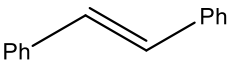
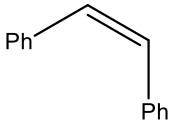


(D)

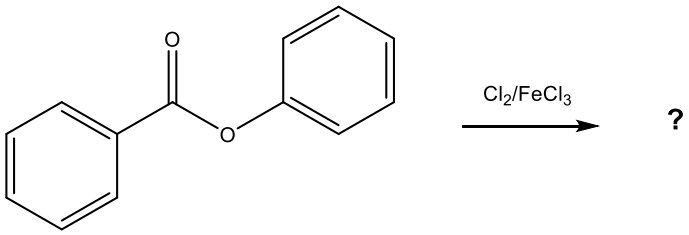


(E)

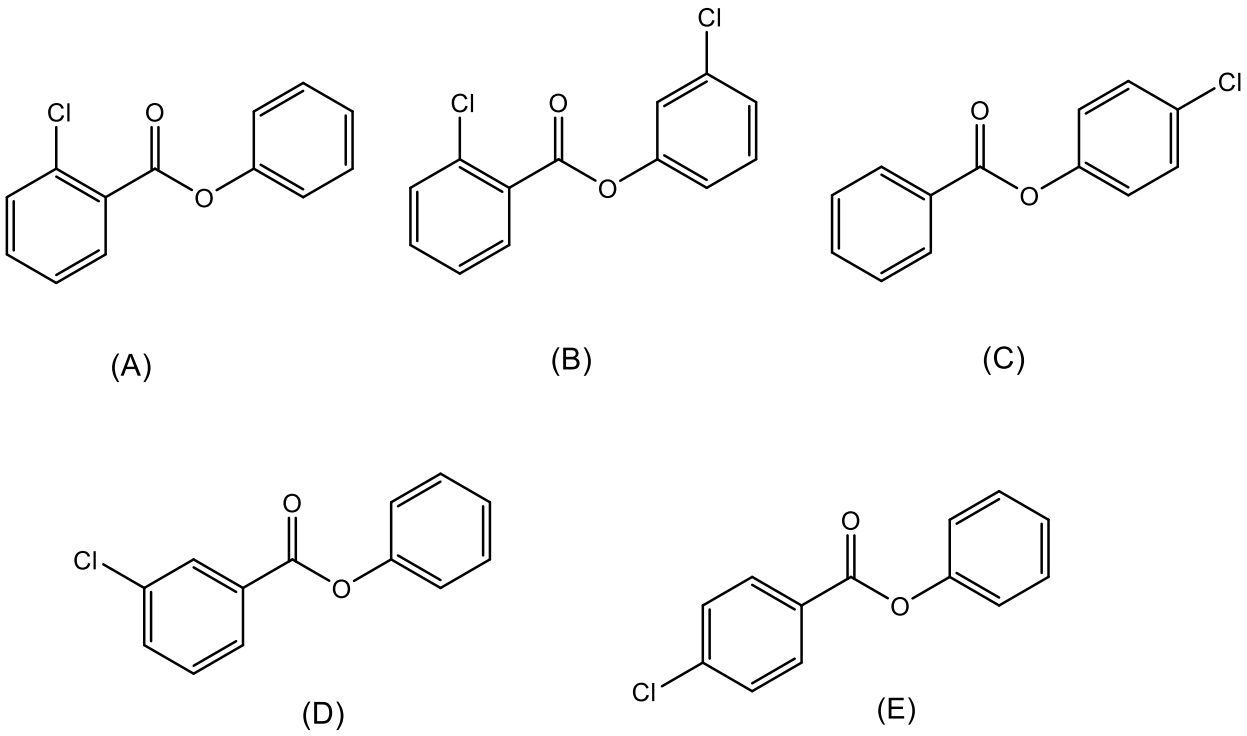


(F)

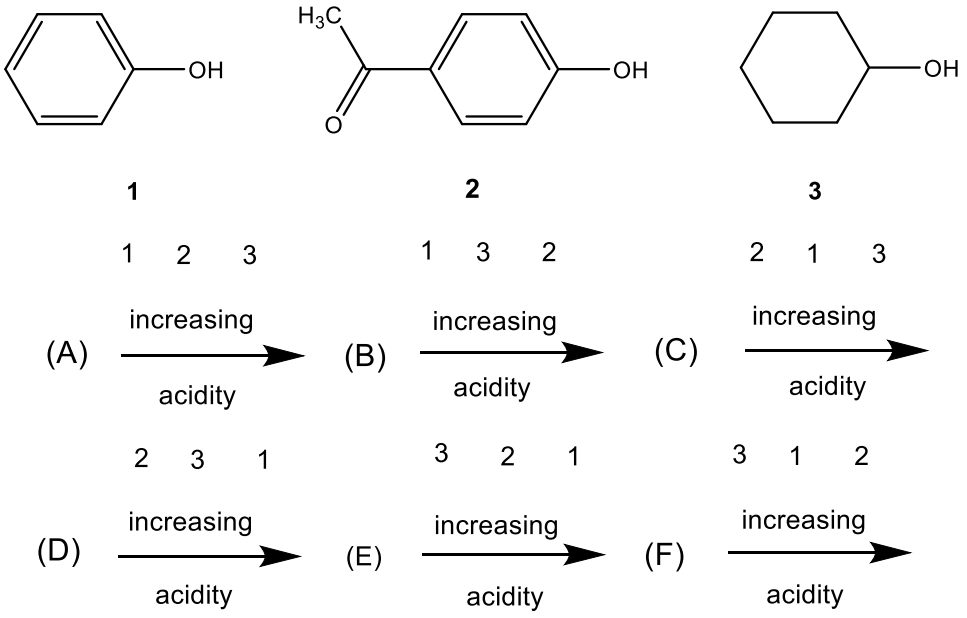
17. Choose the major product of the following reaction.



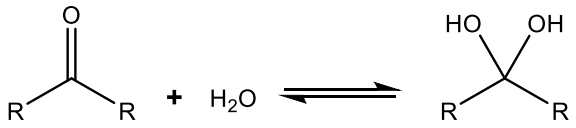
(see next page)

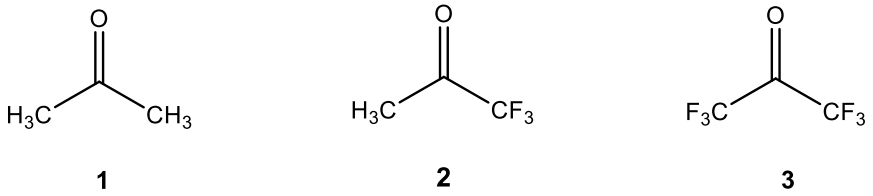


18. Choose the order that has the following compounds correctly arranged with respect to increasing acidity.



19. Choose the order that has the following carbonyl compounds correctly arranged with respect to increasing Ka of hydration.





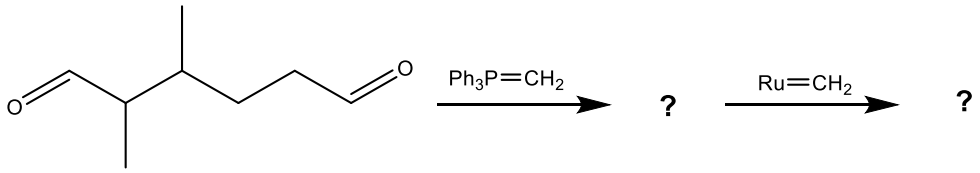
1 2 3 | 1 3 2 | 2 1 3

(A) increasing K_a of hydration (B) increasing K_a of hydration (C) increasing K_a of hydration

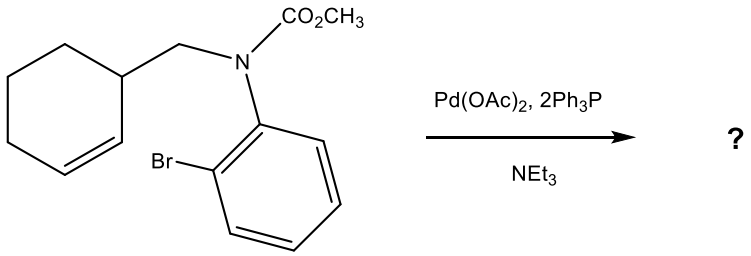
2 3 1 | 3 2 1 | 3 1 2

(D) increasing K_a of hydration (E) increasing K_a of hydration (F) increasing K_a of hydration

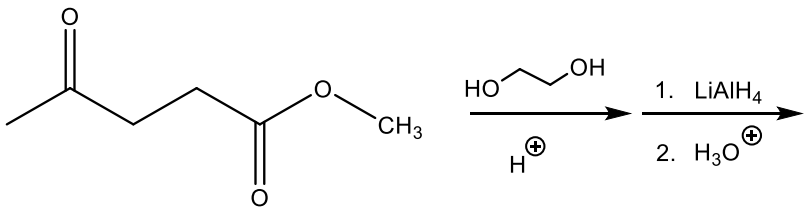
20. Give the structure of the major product of the following reaction sequence.



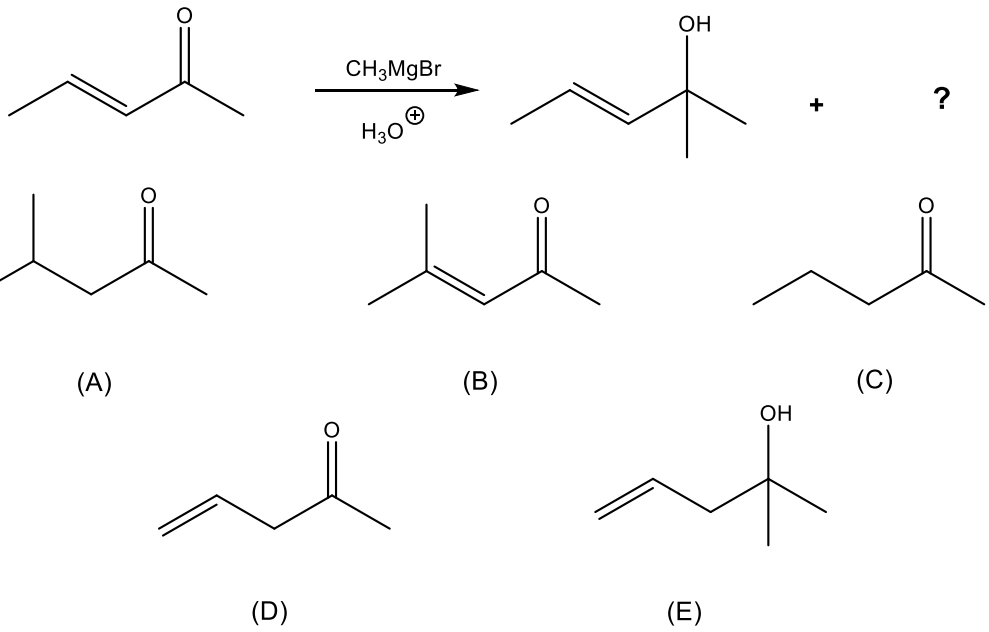
21. Give the major product of the following Heck reaction (hint: pay attention to the stereochemistry of the addition and elimination reactions)



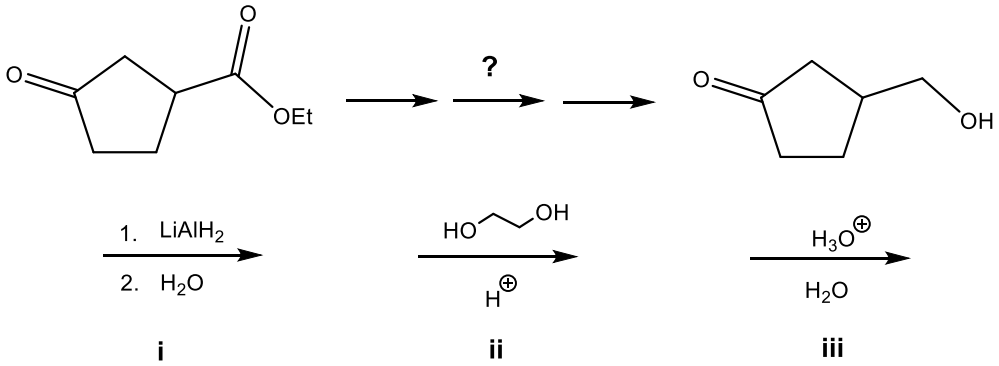
22. Give the major product of the following reaction scheme.



23. Choose the second major product of the following reaction.

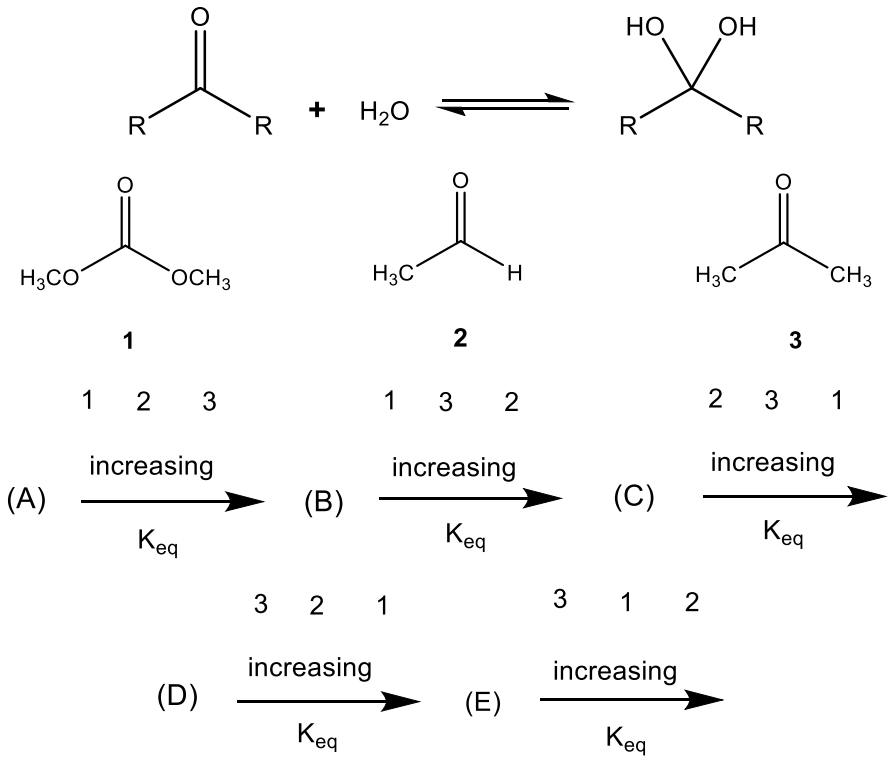


24. Choose the reaction sequence that would be successful for accomplishing the following transformation.

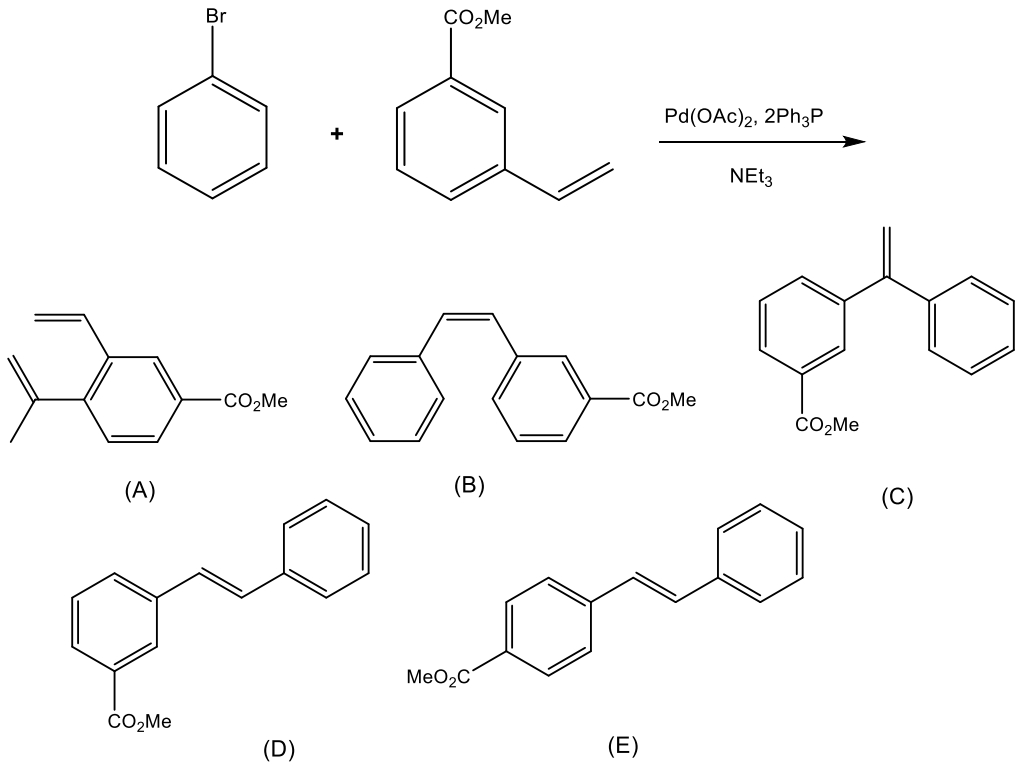


(A) i ii iii (B) ii i iii (C) i iii ii (D) ii iii i (E) iii i ii

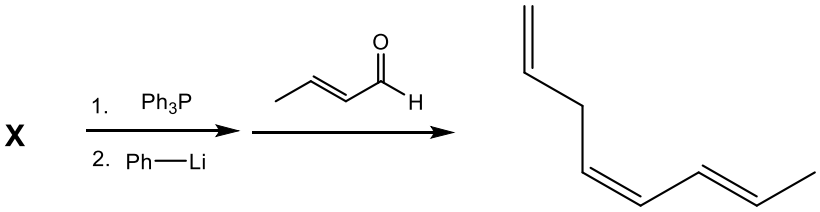
25. Choose the order that has the following carbonyl groups correctly arranged with respect to increasing hydration (increasing K_{eq}).

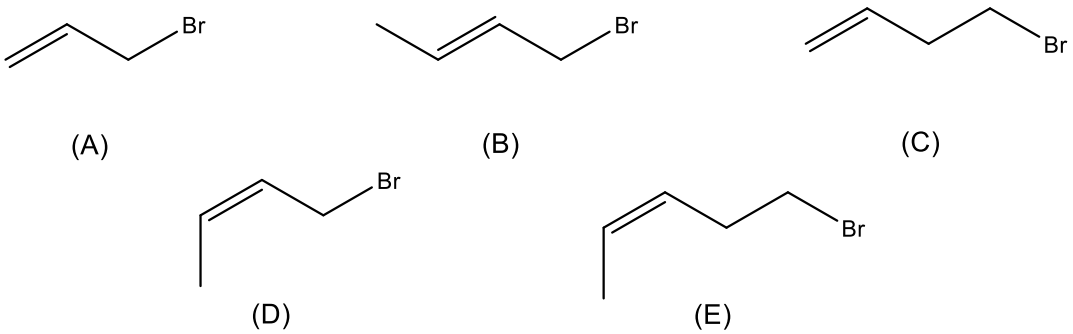


26. Predict the major product of the following organometallic reaction.



27. Identify reagent X in the following reaction.





28. Electron counting is very important for transition metals. Identify the electron count for each of the following compounds.

i. $Pd(PPh_3)_2Cl_2$ **ii.** $Rh(PPh_3)_2ClH_2$

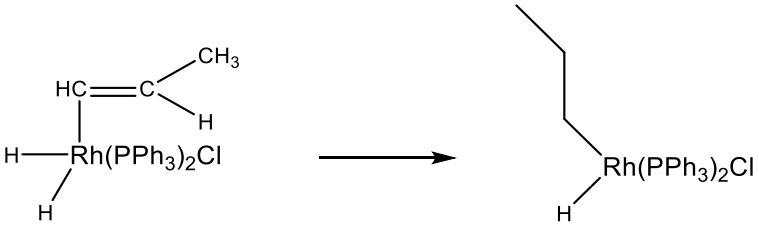
(A) 12 (B) 14 (C) 16 (D) 18 (E) 20

29. Organometallic reaction can be classified by reaction type.

1. Oxidative addition
2. Reductive elimination
3. Ligand association
4. Ligand disassociation
5. Ligand insertion.

Classify the following reactions using these fundamental types.

i.



ii.